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(54) MAGNETO-RESISTANCE EFFECT TYPE MAGNETIC HEAD

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain the anti-ferromagnetic film, in which the exchanging and combining magnetic field is made strong, the blocking temperature is also made high and the temperature characteristic is made superior by making the anti- ferromagnetic layer with first and second anti-ferromagnetic layers, constituting of the first anti-ferromagnetic layer, that directly contact with a ferromagnetic layer, with an ordered Mn alloy having a specific film thickness and making the second anti-ferromagnetic layer with a disordered Mn alloy having a specific film thickness.

SOLUTION: The first anti-ferromagnetic layer is made of an ordered Mn alloy having a film thickness of 10 to 50 A. The second anti-ferromagnetic layer is made of a disordered Mn alloy having a film thickness of 30 to 100 A. The Mn alloy of the first anti-ferromagnetic layer includes more than one kinds of elements selected from the group of Pt, Ni, Rh, Ru, Au and Pd. The Mn alloy of the second anti-ferromagnetic layer includes more than ond kind of elements selected from the group of Pt, Ni, Ir, Rh, Ru, Co, Fe and Pd. It is desirable that the composition of the Mn alloy of the first anti-ferromagnetic layer is Mn 40 to 60 at%. It is also desirable that the composition of the Mn alloy of the second anti-ferromagnetic layer is Mn 50 to 95 at%.

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DERWENT-ACC-NO: 1999-434979

DERWENT-WEEK: 199937

TITLE: Magnetoresistive MR head used in magnetic disc unit - has lamination structure of antiferromagnetic layers formed on upper ferromagnetic layer such that antiferromagnetic layers consist of manganese alloy with different film thicknesses

PATENT-ASSIGNEE: HITACHI LTD[HITA]

PRIORITY-DATA: 1997JP-0335284 (December 5, 1997)

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APPLICATION-DATA:

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ABSTRACTED-PUB-NO: JP 11175919A

BASIC-ABSTRACT:

NOVELTY - The lamination structure of antiferromagnetic layers (14,15,16) is formed on an upper ferromagnetic layer (13). The antiferromagnetic layer contacting the upper ferromagnetic layer, consists of a manganese alloy with

film thickness ranging from 10 to 50 Augstrom. The other antiferromagnetic
layer consists of manganese alloy with film thickness ranging from 30 to 100
Augstrom.

USE - For magnetic disc unit.

ADVANTAGE - Provides reliable high-sensitivity correspondence. Increases shunt
current ratio of MR film, thus obtaining high resistance variation rate.
DESCRIPTION OF DRAWING(S) - The figure shows the sectional view of the outline
of the MR film of an MR head. (13) Upper ferromagnetic layer; (14,15,16)
Antiferromagnetic layers.

CHOSEN-DRAWING: Dwg.1/2

TITLE-TERMS: MAGNETORESISTIVE HEAD MAGNETIC DISC UNIT LAMINATE STRUCTURE
ANTIFERROMAGNETIC LAYER FORMING UPPER FERROMAGNETIC LAYER
ANTIFERROMAGNETIC LAYER CONSIST MANGANESE ALLOY FILM THICK

DERWENT-CLASS: T03

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MAGNETO-RESISTANCE EFFECT TYPE MAGNETIC HEAD

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APPLICANT(s): HITACHI LTD
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ABSTRACT

PROBLEM TO BE SOLVED: To obtain the anti-ferromagnetic film, in which the exchanging and combining magnetic field is made strong, the blocking temperature is also made high and the temperature characteristic is made superior by making the anti- ferromagnetic layer with first and second anti-ferromagnetic layers, constituting of the first anti-ferromagnetic layer, that directly contact with a ferromagnetic layer, with an ordered Mn alloy having a specific film thickness and making the second anti-ferromagnetic layer with a disordered Mn alloy having a specific film thickness.

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Magnetoresistive MR head used in magnetic disc unit - has lamination structure of antiferromagnetic layers formed on upper ferromagnetic layer such that antiferromagnetic layers consist of manganese alloy with different film thicknesses
Patent Assignee: HITACHI LTD (HITA)
Number of Countries: 001 Number of Patents: 001
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Abstract (Basic): JP 11175919 A
NOVELTY - The lamination structure of antiferromagnetic layers (14,15,16) is formed on an upper ferromagnetic layer (13). The antiferromagnetic layer contacting the upper ferromagnetic layer, consists of a manganese alloy with film thickness ranging from 10 to 50 Augstrom. The other antiferromagnetic layer consists of manganese alloy with film thickness ranging from 30 to 100 Augstrom.
USE - For magnetic disc unit.
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Dwg.1/2
Title Terms: MAGNETORESISTIVE; HEAD; MAGNETIC; DISC; UNIT; LAMINATE; STRUCTURE; ANTIFERROMAGNETIC; LAYER; FORMING; UPPER; FERROMAGNETIC; LAYER ; ANTIFERROMAGNETIC; LAYER; CONSIST; MANGANESE; ALLOY; FILM; THICK
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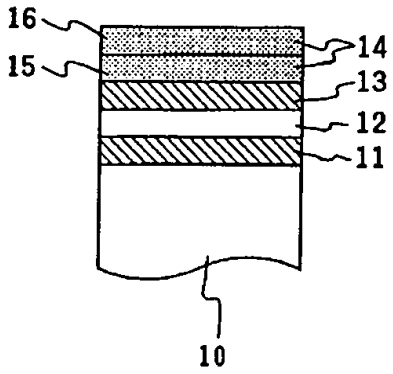
(54)【発明の名称】　磁気抵抗効果型磁気ヘッド

(57)【要約】
【課題】高感度対応の磁気抵抗効果型磁気ヘッドに適用できる反強磁性材として、高交換結合磁界，高ブロッキング温度で薄膜可能な反強磁性膜を提供することを目的とする。
【解決手段】磁気抵抗効果膜の反強磁性層をorder系の反強磁性層とdisorder 系の反強磁性層との積層構造とし、それぞれの膜厚を５ｎｍ以下，１０ｎｍ以下に形成することにより達成される。

図　1



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【特許請求の範囲】

【請求項１】磁気抵抗効果を呈する強磁性層と、該強磁性層に密着する反強磁性層を備えた磁気抵抗効果型ヘッドにおいて、該反強磁性層が第１と第２の反強磁性層からなり、該強磁性層に直接接する第１の反強磁性層の膜厚が１０～５０ÅのOrder 系Ｍｎ合金からなり、第２の反強磁性層の膜厚が３０～１００ÅのDisorder系のＭｎ合金からなることを特徴とする磁気抵抗効果型ヘッド。

【請求項２】該第１の反強磁性層のＭｎ合金は、Ｐｔ，Ｎｉ，Ｒｈ，Ｒｕ，Ａｕ及びＰｄの少なくとも１種以上を含むことを特徴とする請求項１記載の磁気抵抗効果型ヘッド。

【請求項３】該第２の反強磁性層のＭｎ合金は、Ｐｔ，Ｎｉ，Ｉｒ，Ｒｈ，Ｒｕ，Ｃｏ，Ｆｅ及びＰｄの少なくとも１種以上を含むことを特徴とする請求項１に記載の磁気抵抗効果型ヘッド。

【請求項４】該第１の反強磁性層のＭｎ合金の組成は、Ｍｎ４０～６０ａｔ％であることを特徴とする請求項１及び２記載の磁気抵抗効果型ヘッド。

【請求項５】該第２の反強磁性層のＭｎ合金の組成は、Ｍｎ５０～９５ａｔ％であることを特徴とする請求項１及び３記載の磁気抵抗効果型ヘッド。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、磁気媒体から情報信号を読み取るための磁気抵抗効果を利用した磁気抵抗効果ヘッドに関するものである。

【０００２】

【従来の技術】磁気記録の高密度化に伴い、高感度な再生用ヘッドが求められており、その再生ヘッドとしては、磁気抵抗効果（ＭＲ）を利用した磁気抵抗効果型ヘッドが用いられている。現在磁気ディスク装置に搭載されているＭＲヘッドは、磁性膜の磁化の方向と信号検出電流とのなす角度に依存して抵抗が変化する異方性磁気抵抗効果が用いられている。ＭＲヘッドにおいて、外部磁界を感知して抵抗が変化する部分（感磁部）にはＮｉＦｅ膜が用いられており、その磁気抵抗変化率は最大で約３％である。そのため、数Ｇｂ／in² 程度の高面記録密度になるとこの異方性磁気抵抗効果を用いたＭＲヘッドでは感度不足になることが予想され、より高感度な磁気抵抗変化を示すものが要求されている。

【０００３】近年、Ｃｏ／Ｃｕ，Ｆｅ／Ｃｒ或いはＮｉＦｅ／Ｃｕのように強磁性膜と非磁性導電性膜とを交互に積層させた多層構造で、強磁性膜間の反強磁性的結合を利用して巨大な磁気抵抗効果（ＧＭＲ）が得られることが報告された。しかしながら、この磁気抵抗変化率を得るために必要な飽和磁界は数ｋＯｅと非常に高く、実際のＭＲヘッドに適用するには困難である。

【０００４】一方、２層の強磁性膜を非磁性導電性膜で分離し、一方の強磁性膜に反強磁性膜を隣接して磁化の

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方向を固定させ、もう一方の強磁性膜が外部磁界により磁化反転し、２層の強磁性膜の互いの磁化方向のなす角度によって高い磁気抵抗変化が得られることが報告されている（米国出願7－62534号，１９９０年１２月１１日出願）。これはスピンバルブ（ＳＶ）構造と呼ばれ、比較的小さな磁界で飽和し、次世代の磁気ヘッド用磁気抵抗効果膜として現在最も注目されている。

【０００５】スピンバルブ膜に用いられる反強磁性膜として、一般にDesorder系の反強磁性膜であるＦｅＭｎ合金，Ｍｎ Ｉｒ合金が知られている。Disorder系は、膜厚が数ｎｍでも交換結合磁界が得られること、熱処理を施す必要が無いことなどの利点がある一方、ブロッキング温度が低く、又耐熱性が悪いため、膜作製プロセス中の温度上昇により交換結合磁界が変化してしまうという問題がある。

【０００６】一方、特開平6－76247 号公報記載のOrder系の反強磁性膜であるＮｉＭｎ合金は、ブロッキング温度が約４００℃と高く，膜作製プロセス中の温度上昇にも、安定で良好な交換結合磁界が得られる。しかし、交換結合磁界を得るための熱処理が２４０～２６０℃で１０数時間必要なこと，膜厚が２０ｎｍまでしか薄く出来ないことなどの問題がある。

【０００７】１９９７年６月に公開された特開平9－147325 号公報には、この反強磁性膜としてＰｔＭｎ合金，ＲｈＭｎ合金，ＩｒＭｎ合金を用いて熱処理を施した磁気抵抗効果型磁気ヘッドを開示している。これは、上記反強磁性膜を熱処理することによって強磁性膜との界面に拡散層を生成し、高ブロッキング温度で交換結合磁界が高く、しかも従来のOrder 系の反強磁性膜に比べて薄膜化できるというものである。

【０００８】

【発明が解決しようとする課題】本発明の目的は、高感度用磁気抵抗効果ヘッドに適用できる反強磁性材として、交換結合磁界が高く高ブロッキング温度で、しかも温度特性にすぐれ、１５ｎｍ以下に薄膜化できる反強磁性膜を提供することにある。

【０００９】

【課題を解決するための手段】上記目的は、磁気抵抗効果を呈する強磁性層と、該強磁性層に密着する反強磁性層を備えた磁気抵抗効果型ヘッドにおいて、該反強磁性層が第１と第２の反強磁性層からなり、該強磁性層に直接接する第１の反強磁性層を膜厚１０～５０ÅのOrder系Ｍｎ合金とし、第２の反強磁性層を膜厚３０～１００ÅのDisorder 系のＭｎ合金とすることで達成できる。

【００１０】更に、該第１の反強磁性層のＭｎ合金が、Ｐｔ，Ｎｉ，Ｒｈ，Ｒｕ，Ａｕ及びＰｄの少なくとも１種以上を含むこと、該第２の反強磁性層のＭｎ合金が、Ｐｔ，Ｎｉ，Ｉｒ，Ｒｈ，Ｒｕ，Ｃｏ，Ｆｅ及びＰｄの少なくとも１種以上を含むことで達成できる。また、該第１の反強磁性層のＭｎ合金の組成を、Ｍｎ４０～６０

at%とすること、該第2の反強磁性層のMn合金の組成を、Mn50～95at%とすることで達成できる。

【0011】

【発明の実施の形態】以下に本発明の実施例を示す。

【0012】（実施例）本発明に従うスピンバルブ膜の概略図を図1に示す。

【0013】図1に示されるスピンバルブ構造の磁気抵抗効果膜10は、第1の強磁性膜11，非磁性導電性膜12，第2の強磁性膜13及び反強磁性膜14から構成されている。第1の強磁性膜11と第2の強磁性膜13の面内磁化は、外部磁界が印加されていない状態でお互いに対して90度傾いた方向に向けられている。さらに第2の強磁性膜13は、反強磁性膜14によって、好ましい方向に磁化が固定されている。媒体からの磁界により、第1の強磁性膜11の磁化は自由に回転し、それにより抵抗変化が生じて出力が発生する。

【0014】本発明によると、反強磁性膜14は、order系のMn合金からなる第1の反強磁性膜15とdisorder系のMn合金からなる第2の反強磁性膜16からなる。また、上記磁気抵抗効果膜10を基板側から反強磁性膜14／第2の強磁性膜13／非磁性導電性膜12／第1の強磁性膜11とすることも出来る。更に、第1及び第2の強磁性膜の一方あるいは両方を2層以上の構造にすることも可能である。

【0015】スピンバルブ型磁気抵抗効果膜10を用いた本発明の一実施例を図2に説明する。基板21の上に、磁気抵抗効果膜10の配向性を良くするための下地＊膜22であるTa5nm，第1の強磁性膜11であるNiFe5nm，Co2nm，非磁性導電性膜12であるCu2nm，第2の強磁性膜13であるCo3nm，第1の反強磁性膜15であるMnPt3nm、第2の反強磁性膜16であるMnIr6nm、さらに保護膜24であるTa5nmを順次形成し、所定の形状にパターニングする。このときのMnPtの組成は、50Mn－50Pt（at%）、MnIrの組成は80Mn－20Ir（at%）である。

【0016】次に、リフトオフ用ホトレジスト層を形成したあと、永久磁石膜であるCoCrPt40nmを積層し、縦バイアス印加層25を形成する。次に、電極膜26であるAu0.2μm を形成したあと、リフトオフ用レジスト層を除去する。さらに、真空中で1kOeの磁界を媒体対向面と垂直に印加しながら、230℃で4時間熱処理して、第1の反強磁性膜15であるMnPtをorder化し、本発明のGMRヘッドを作製する。

【0017】本実施例では、スピンバルブ膜の第1の反強磁性膜15としてMnPtを用いたが、特にこれに限定されることはなく、order系のMn－X1合金（X1：Ni，Pd，Au，Rh，Ru）を用いることもできる。さらに、第2の反強磁性膜16として、MnIrを用いたが、他のdisorder系のMn－X2合金（X2：Pt，Ni，Rh，Ru，Co，Fe，Pd）を用いることもできる。

【0018】

【表1】

表　1

材　　料	膜厚(nm)	Ke(erg/cm^2)	Tb(℃)	熱処理温度(℃)
NiMn(o)	20	0.32	400	250
PtMn(o)	20	0.32	380	230
MnPt(o)/MnIr(d)	9	0.25	320	230
NiMn(o)/MnIr(d)	9	0.25	330	250
MnPt(o)/MnRh(d)	9	0.25	320	230
MnPt(o)/FeMn(d)	8	0.24	300	230
MnPt(o)/CoMnPt(d)	9	0.20	280	230
MnIr(d)	6	0.19	240	—
FeMn(d)	5	0.20	200	—

【0019】表1は、本発明の代表的なスピンバルブ膜の反強磁性膜の膜厚と、交換結合エネルギKe，ブロッキング温度Tb及び熱処理温度をまとめたものである。比較のために、order系で代表的なNiMn及びPtMn，disorder系で代表的なMnIr及びFeMnの特性も合わせて示す。MnPt／MnIr積層膜は、Keが0.25erg／cm^2 、Tbが320℃とdisordre系材料(MnIr，FeMn)に比較して大きく、これらの特性を得るための熱処理も従来のorder系材料（NiMn，PtMn）に比較して十分低い。さらに、膜厚を10nm以下に薄膜化できることが分かった。他の材料の積層膜についても同様で、高ブロッキング，高交換結合磁界が得ら

れ、且つ薄膜化が可能であることが分かった。

【００２０】上記実施例では、磁気抵抗効果膜１０を基板側から第１の強磁性膜１１／非磁性導電性膜１２／第２の強磁性膜１３／第１の反強磁性膜１５／第２の反強磁性膜１６の順に積層したが、逆に基板側から第２の反強磁性膜１６／第１の反強磁性膜１５／第２の強磁性膜１３／非磁性導電性膜１２／第１の強磁性膜１１と配置することもできる。

【００２１】また本実施例では、縦バイアス印加層として永久磁石膜であるCoCrPtを用いたが、特にこれに限定されることはない。たとえば反強磁性膜を用いることも可能で、この場合下地膜として強磁性膜を形成する必要がある。この場合、第２の強磁性膜１３の磁化を固定するための反強磁性膜１４と、縦バイアス印加層に用いている反強磁性膜２５の着磁方向がお互いに対して９０°傾いているため、ブロッキング温度の異なる材料を用いる必要がある。

【００２２】この時、第２の強磁性膜１３／反強磁性膜１４との間の交換結合磁界が、縦バイアス印加層２５の強磁性膜／反強磁性膜との間の交換結合磁界よりも大きい方が好ましい。

【００２３】また、さらに高感度対応のデュアル構造ヘッド及びＴＭＲ構造ヘッドに用いることも可能である。＊

＊【００２４】

【発明の効果】磁気抵抗効果を呈する強磁性層と、それに密着する反強磁性層を備えた磁気抵抗効果型ヘッドにおいて、反強磁性層をorder系の反強磁性層とdisorder系の反強磁性層との積層構造とし、それぞれの膜厚を５ｎｍ以下、１０ｎｍ以下に形成することにより、磁気抵抗効果膜の分流比が上がり、高い抵抗変化率が得られる。さらに、ブロッキング温度が、膜作製プロセス温度あるいは稼働時の上昇温度に比較して高く、信頼性の高い高感度な磁気抵抗効果型ヘッドを提供することができる。

【図面の簡単な説明】

【図１】本発明の実施例である磁気抵抗効果膜の概略を示す断面図。

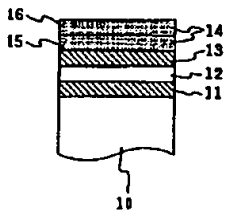
【図２】本発明の実施例である磁気抵抗効果型磁気ヘッドの概略断面図。

【符号の説明】

１０，２３…スピンバルブ構造の磁気抵抗効果膜、１１，１３…強磁性膜、１２…非磁性導電性膜、１４，１５，１６…反強磁性膜、２０…磁気抵抗効果型ヘッド、２１…基板、２２…下地膜、２４…保護膜、２５…縦バイアス印加層、２６…電極。

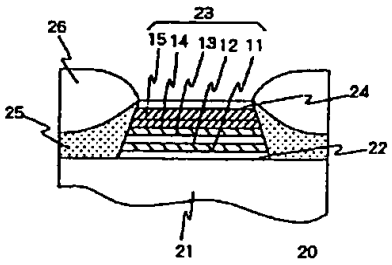
【図１】

図 1



【図２】

図 2



* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the magnetoresistance-effect head using the magnetoresistance effect for reading an information signal in a magnetic medium.
[0002]
[Description of the Prior Art] In connection with the densification of magnetic recording, the high sensitivity head for reproduction is called for and the magnetoresistance-effect type head using the magnetoresistance effect (MR) is used as the reproducing head. As for the MR head carried in the present magnetic disk unit, the anisotropy magnetoresistance effect from which resistance changes depending on the angle of the direction of magnetization of a magnetic film and signal-detection current to make is used. In an MR head, the NiFe film is used for the portion (magnetic force sencor) from which an external magnetic field is sensed and resistance changes, and the magnetic-reluctance rate of change is about 3% at the maximum. Therefore, it is 2 several Gb/inch. If it becomes the high side recording density of a grade, a bird clapper is expected by the shortage of sensitivity and the MR head using this anisotropy magnetoresistance effect requires what shows a high sensitivity magnetic-reluctance change.
[0003] It was reported that the huge magnetoresistance effect (GMR) is acquired in recent years using the antiferromagnetism-combination between ferromagnetics by the multilayer structure to which the laminating of a ferromagnetic and the nonmagnetic conductivity film was carried out by turns like Co/Cu, Fe/Cr, or NiFe/Cu. However, the saturation magnetic field required in order to obtain this magnetic-reluctance rate of change is difficult for being very as high as Number kOe and applying to an actual MR head.
[0004] On the other hand, a nonmagnetic conductivity film separates a two-layer ferromagnetic, adjoin one ferromagnetic in an antiferromagnetism film, the direction of magnetization is made to fix, another ferromagnetic carries out flux reversal by the external magnetic field, and it is reported that a high magnetic-reluctance change is obtained with the angle which the mutual magnetization direction of a two-layer ferromagnetic makes (the U.S. application No. 62534 [seven to], December 11, 1990 application). This is called spin bulb (simian virus) structure, is saturated with a comparatively small magnetic field, and attracts attention most as a magnetoresistance-effect film for the magnetic heads of the next generation now.
[0005] As an antiferromagnetism film used for a spin bulb film, the FeMn alloy and MnIr alloy which are generally the antiferromagnetism film of a desorder system are known. While a disorder system has advantages, like there is no need that thickness performs that a several nm switched connection magnetic field is acquired and heat treatment, since thermal resistance is bad, it has the problem that a switched connection magnetic field will change with the temperature rises in a film production process, low [blocking temperature].
[0006] On the other hand, the NiMn alloy which is the antiferromagnetism film of an order system given in JP,6-76247,A has blocking temperature as high as about 400 degrees C, and a stable and good

switched connection magnetic field is acquired by the temperature rise in a film production process. However, there are problems, like needing to be heat-treated of 240-260 degrees C for about ten hours for acquiring a switched connection magnetic field and thickness is thinly made only to 20nm.
[0007] In JP,9-147325,A exhibited in June, 1997, the magnetoresistance-effect type magnetic head which heat-treated using a PtMn alloy, a RhMn alloy, and an IrMn alloy as this antiferromagnetism film is indicated. By heat-treating the above-mentioned antiferromagnetism film, a diffusion layer is generated to an interface with a ferromagnetic, a switched connection magnetic field is high at high blocking temperature, and, moreover, this is the conventional order.-izing can be carried out [thin film] compared with the antiferromagnetism film of a system.
[0008]
[Problem(s) to be Solved by the Invention] As antiferromagnetism material applicable to the magnetoresistance-effect head for high sensitivity, the purpose of this invention is high blocking temperature highly, and moreover a switched connection magnetic field is excellent in the temperature characteristic, and is to offer the antiferromagnetism film which can carry out [thin film]-izing to 15nm or less.
[0009]
[Means for Solving the Problem] In the magnetoresistance-effect type head equipped with the ferromagnetic layer which the above-mentioned purpose presents the magnetoresistance effect, and the antiferromagnetism layer stuck to this ferromagnetic layer This antiferromagnetism layer consists of the 1st and 2nd antiferromagnetism layer, the 1st antiferromagnetism layer which touches this ferromagnetic layer directly is used as the order system Mn alloy of 10-50A of thickness, and it is disorder of 30-100A of thickness about the 2nd antiferromagnetism layer. It can attain by considering as Mn alloy of a system.
[0010] furthermore -- this -- Mn alloy of the 1st antiferromagnetism layer contains at least one or more sorts of Pt, nickel, Rh, Ru, Au, and Pd -- this -- Mn alloy of the 2nd antiferromagnetism layer can attain by at least one or more sorts of Pt, nickel, Ir, Rh, Ru, Co, Fe, and Pd being included moreover -- this -- making composition of Mn alloy of the 1st antiferromagnetism layer into Mn40 - 60at% -- this -- it can attain by making composition of Mn alloy of the 2nd antiferromagnetism layer into Mn50 - 95at%
[0011]
[Embodiments of the Invention] The example of this invention is shown below.
[0012] (Example) The schematic diagram of the spin bulb film according to this invention is shown in drawing 1 .
[0013] The magnetoresistance-effect film 10 of the spin bulb structure shown in drawing 1 consists of the 1st ferromagnetic 11, nonmagnetic conductivity film 12, 2nd ferromagnetic 13, and antiferromagnetism film 14. the magnetization within a field of the 1st ferromagnetic 11 and the 2nd ferromagnetic 13 is turned in the direction to which was mutual-resembled, was received in the state where the external magnetic field is not impressed, and it inclined 90 degrees Furthermore, as for the 2nd ferromagnetic 13, magnetization is being fixed in the desirable direction with the antiferromagnetism film 14. By the magnetic field from a medium, it rotates freely, resistance change arises by that cause, and an output generates magnetization of the 1st ferromagnetic 11.
[0014] According to this invention, the antiferromagnetism film 14 is order. It consists of the 2nd antiferromagnetism film 16 which consists of the 1st antiferromagnetism film 15 and Mn alloy of a disorder system which consist of a Mn alloy of a system. Moreover, also let the above-mentioned magnetoresistance-effect films 10 be the antiferromagnetism film 14 / the 2nd ferromagnetic 13 / nonmagnetic conductivity film 12 / ferromagnetic 11 from a substrate side. [1st] Furthermore, it is also possible to make both the 1st, and both [one side or] into the structure more than two-layer. [the] [of a ferromagnetic]
[0015] One example of this invention using the spin bulb type magnetoresistance-effect film 10 is explained to drawing 2 . On a substrate 21 Ta5nm which is the ground film 22 for improving the stacking tendency of the magnetoresistance-effect film 10, NiFe5nm which is the 1st ferromagnetic 11, Co2nm, Cu2nm which is the nonmagnetic conductivity film 12, Co3nm which is the 2nd ferromagnetic

13, MnPt3nm which is the 1st antiferromagnetism film 15, MnIr which is the 2nd antiferromagnetism film 16 -- Ta5nm which is a protective coat 24 further is formed one by one 6 nm, and patterning is carried out to a predetermined configuration The composition of 50Mn-50Pt (at%) and MnIr of composition of MnPt at this time is 80Mn-20Ir (at%).

[0016] Next, after forming the photoresist layer for lift offs, the laminating of the CoCrPt40nm which is a permanent magnet film is carried out, and the vertical bias impression layer 25 is formed. Next, Au0.2micrometer which is an electrode layer 26 After forming, the resist layer for lift offs is removed. Furthermore, impressing the magnetic field of 1kOe to a medium opposite side and a perpendicular in a vacuum, it heat-treats at 230 degrees C for 4 hours, MnPt which is the 1st antiferromagnetism film 15 is turned order, and the GMR head of this invention is produced.

[0017] Although MnPt was used as 1st antiferromagnetism film 15 of a spin bulb film in this example, it is not limited to especially this, and it is order. Mn-X1 alloy (X1:nickel, Pd, Au, Rh, Ru) of a system can also be used. Furthermore, as 2nd antiferromagnetism film 16, although MnIr was used, they are other disorder(s). Mn-X2 alloy (X2 :P t, nickel, Rh, Ru, Co, Fe, and Pd.) of a system can also be used.

[0018]

[Table 1]

表 1

材　　料	膜厚(nm)	Ke(erg/cm^2)	Tb(℃)	熱処理温度(℃)
NiMn(o)	20	0.32	400	250
PtMn(o)	20	0.32	380	230
MnPt(o)/MnIr(d)	9	0.25	320	230
NiMn(o)/MnIr(d)	9	0.25	330	250
MnPt(o)/MnRh(d)	9	0.25	320	230
MnPt(o)/FeMn(d)	8	0.24	300	230
MnPt(o)/CoMnPt(d)	9	0.20	280	230
MnIr(d)	6	0.19	240	—
FeMn(d)	5	0.20	200	—

[0019] Table 1 summarizes the thickness, the switched connection energy Ke and the blocking temperature Tb, and heat treatment temperature of an antiferromagnetism film of this invention. [of a typical spin bulb film] NiMn and PtMn typical by the order system for comparison, and disorder A system also doubles and shows the property of typical MnIr and FeMn. A MnPt/MnIr cascade screen is order of the former [heat treatment / for 0.25 erg/cm2 and Tb of Ke being large as compared with 320 degrees C and disordre system material (MnIr, FeMn), and acquiring these properties]. As compared with system material (NiMn, PtMn), it is low enough. Furthermore, it turns out that-izing of the thickness can be carried out [thin film] to 10nm or less. The same was said of the cascade screen of other materials, and high blocking and the high switched connection magnetic field were acquired, and it turns out that thin-film-izing is possible.

[0020] In the above-mentioned example, although the laminating of the magnetoresistance-effect film 10 was carried out to the order of the 1st ferromagnetic 11 / nonmagnetic conductivity film 12 / 2nd ferromagnetic 13 / 1st antiferromagnetism film 15 / 2nd antiferromagnetism film 16 from the substrate side, it can also arrange from a substrate side conversely with the 2nd antiferromagnetism film 16 / 1st antiferromagnetism film 15 / the 2nd ferromagnetic 13 / nonmagnetic conductivity film 12 / ferromagnetic 11. [1st]

[0021] Moreover, although CoCrPt which is a permanent magnet film as a vertical bias impression layer

was used in this example, it is not limited to especially this. For example, it is also possible to use an antiferromagnetism film and it needs to form a ferromagnetic as a ground film in this case. In this case, since the 90 degrees of the magnetization directions of the antiferromagnetism film 14 for fixing magnetization of the 2nd ferromagnetic 13 and the antiferromagnetism film 25 used for the vertical bias impression layer lean to each other, it is necessary to use the material from which blocking temperature differs.

[0022] At this time, the one where the switched connection magnetic field between the 2nd 13/antiferromagnetism film 14 of ferromagnetics is larger than the switched connection magnetic field between the ferromagnetic / antiferromagnetism film of the vertical bias impression layer 25 is desirable.

[0023] Furthermore, it is also possible to use for the dual structure head and TMR structure head dealing with high sensitivity.

[0024]

[Effect of the Invention] It sets on the magnetoresistance-effect type head equipped with the ferromagnetic layer which presents the magnetoresistance effect, and the antiferromagnetism layer stuck to it, and is the antiferromagnetism layer and disorder of an order system about an antiferromagnetism layer. By considering as a laminated structure with the antiferromagnetism layer of a system, and forming each thickness in 5nm or less and 10nm or less, the diverging ratio of a magnetoresistance-effect film goes up, and high resistance rate of change is obtained. Furthermore, blocking temperature is high as compared with film production process temperature or the rise temperature at the time of operation, and can offer a reliable high sensitivity magnetoresistance-effect type head.

[Translation done.]

* NOTICES *

1. This document has been translated by computer.So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The ferromagnetic layer which presents the magnetoresistance effect. The antiferromagnetism layer stuck to this ferromagnetic layer. order whose thickness of the 1st antiferromagnetism layer which touches this ferromagnetic layer directly by being the magnetoresistance-effect type head equipped with the above, and this antiferromagnetism layer consisting of the 1st and 2nd antiferromagnetism layer is 10-50A It consists of a system Mn alloy and is characterized by the bird clapper from Mn alloy of the disorder system whose thickness of the 2nd antiferromagnetism layer is 30-100A.
[Claim 2] this -- the magnetoresistance-effect type head according to claim 1 characterized by Mn alloy of the 1st antiferromagnetism layer containing at least one or more sorts of Pt, nickel, Rh, Ru, Au, and Pd
[Claim 3] this -- the magnetoresistance-effect type head according to claim 1 characterized by Mn alloy of the 2nd antiferromagnetism layer containing at least one or more sorts of Pt, nickel, Ir, Rh, Ru, Co, Fe, and Pd
[Claim 4] this -- the claim 1 characterized by composition of Mn alloy of the 1st antiferromagnetism layer being Mn40 - 60at%, and a magnetoresistance-effect type head given in two
[Claim 5] this -- the claim 1 characterized by composition of Mn alloy of the 2nd antiferromagnetism layer being Mn50 - 95at%, and a magnetoresistance-effect type head given in three

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[Translation done.]